International Journal of Environment, Ecology, Family and Urban Studies (IJEEFUS)
ISSN(P): 2250-0065; ISSN(E): 2321-0109
Vol. 4, Issue 2, Apr 2014, 1-8

TRANS STELLAR
• Journal Publications • Research Consultancy

ASSESSMENT OF LAND USE/ LAND COVER CHANGES IN THE UPPER BENUE REGION ADAMAWA STATE, NIGERIA

ABUBAKAR, BASHIR

Department of Geography, Modibbo Adama University of Technology, Yola, Nigeria

ABSTRACT

The aim of this paper was to analyse land use/ land cover (LU/LC) changes between 1975, 1987 and 2005 in the flood plain of river Benue using satellite images. Land SAT MSS image of 1975, Land SAT ETM images of 1987 and 2005 were used to determine the changes in land use/land cover over a period of 30 years. Using Arc GIS 9.3, the images were classified into eight(8) land use/ land cover types namely Built up areas, Water bodies, Crop lands, Grassland, Green landscape belts, Marshy green lands, Open spaces and Forest gallery. Significant changes occur in all classes of Land use/ Land cover between 1975, 1987 and 2005. the result reveals an increase in Built up areas, Cropland and decrease in Forest gallery, Marshy grassland and Open spaces within the study period (1975 – 2005) . Within this period, Built up area increase from 5% in 1995 to 13.8% in 1987 and 15.3% in 2005, while forest gallery decreased from 8.9% in 1975, to 3.6% in 1987 and 2.24% in 2005.Based on the pattern of changes shown by this study, recommendation aimed at ensuring a sustainable resources management within the area such as the adaption of affore station and agro forestry were proffered.

KEYWORDS: Land Use / Land Cover, Flood Plain, Land Resources Management, Geo Referencing

INTRODUCTION

Application of Geographic Information System and Remote Sensing technology provide a very sound basis for the assessment of land use/ land cover, due to its advantage in being spatially comprehensive in its coverage and its ability to be used in change detection due to the fact that repetitive coverage satellites at short interval. Geographic Information System and Remote Sensing provide some of the most accurate means of measuring the extent and pattern of changes in land scape condition over time (Miller et al 1985) Land Use/Land Cover mapping is facilitated by a reflective wavelength from the solar spectrum, after which the reflected rays are classified into different classes of land use.

The most commonly used land cover change detection method as identified by Duadze, (2004) include (i) Image overlay (ii) Classification comparisons of land cover statistics (iii) Change vector analysis (iv) Principal component analysis (v) Image rationing and (vi) The differencing of Normalized Difference Vegetation Index (NDVI), in addition to these change detection methods there are other methods such as Comparison of Land Cover Classifications (Todd, 1977, Howarth and Wickware, 1981). Multi date Classification (Estes et al, 1982, Schowerngert 1983), Post Classification Comparison (Gordon, 1980, Joyce et al, 1982, Mas, 1999) and Principal Component Analysis (Richardson And Milas, 1983, Sigh, 1984).

The objectives of the digital change detection as identified by IGBP and IHDP (1999) include knowing the pattern of land cover change over space and time, knowing the processes of land cover changes and knowing the nature of human response to land use/ land cover changes. However, the main objective of this paper is the analysis of the pattern of Land Use/ Land Cover Changes in the flood plain of river Benue.

The Study Area

The area selected for this study is located between latitude $9^0\ 02^I$ and $9^0\ 30^I$ N $12^0\ 20^I$ to $12^0\ 54^I$ E. It is traversed by the segment of river Benue / forming a fluvial system). This area occupies approximately 3288.5km^2. It has a population of about 20,855 person (NPC, 2006). The climate of the area is a typical tropical savannah climate with distinct wet and dry season. The rainy season last for an average of 6 months from May to October, with an average of 41% of the rain falling in August and September. The mean annual rain fall ranges between 850 – 1000mm. all location within the study area have a fairly uniform climate as they are in the same latitude, and on flat terrain devoid of altitudinal influence on the local climate.

The topography of the area is generally low laying flat terrain of 183.3 – 200 metres ASL with gentle undulation and hills ranges punctuating the extensive flat flow plain at various locations notably across the river Benue eastward from Jimeta, the land rises steeply to attend a maximum height of 240metres above mean sea level (Makpene 2007). The geology of the area is made up of two units namely; the Bima sandstone and the alluvial sand deposit. Alluvial sand deposit formed the bank material which confines the river, it is a recently deposit sandy loam deposit with very low cohesion.

The vegetation cover around the channel segment was a woody savannah made up of gallery of different plant species; however, the primary vegetation in the area has since being replaced with a secondary vegetation and a grassland scenery that constituted a pastoral block (Tukur and Ardo,1999). The agricultural, water, and land resources potentials of the area have attracted a considerable intensity of human activities that have transformed the general land use pattern within the study area. The trajectory of land use/land cover in the study area within the 30years period has been a decrease in forest cover and increase in cropland and built up area, this is a reflection of the demographic dynamics and political developments within the study area. The map of the study area is presented below.

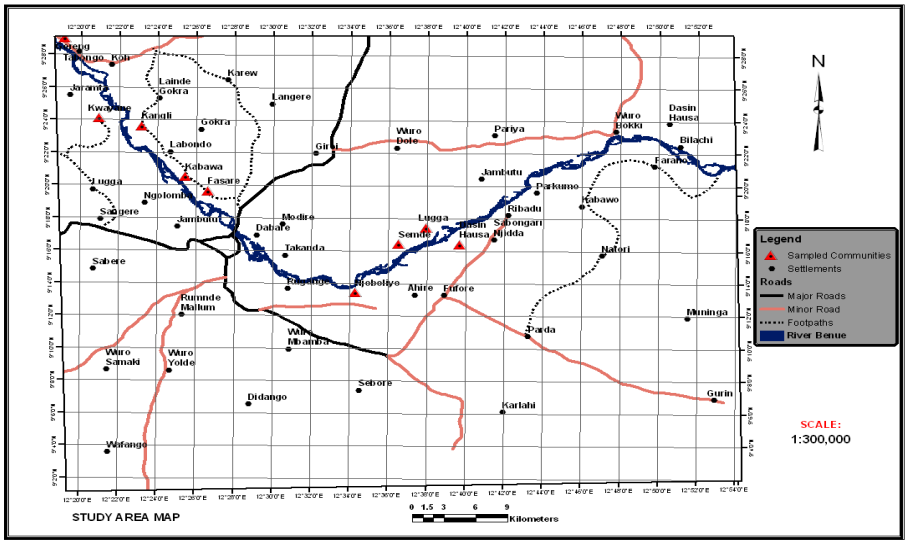

Figure 1: The Study Area

MATERIALS AND METHODS

The materials used for this study are LandSAT MSS image of 1975 and LandSAT ETM images of 1987 and 2005 the images were taken in December 1975, 1987 and 2005, when there was little or no cloud cover during these period. The method adapted for this study is divided into three stages namely (i) Data preparation, (ii) Changes detection in Landuse/Landcover (iii) Evaluation of Landuse/Landcover classification.

Data Preparation

Three Landsat Images of the study area were used for this study. The satellite images are Landsat MSS images of 1975, and LandSat ETM Images of 1987 and 2005. Using a georef corner module of ArcGIS9.3 a reference frame is created for the study area. A reference frame is a georef object that stores the aerial extent, spatial resolution, row/column size and geographic co-ordinates that were used in mapping the area studied.

In order for all the images to have the same number of rows and columns, coordinate system and spatial resolution (a Prerequisite for GIS manipulations to be possible), each of the image was re-sampled to the reference frame. Re sampling to the reference frame ensures that the images inherit all the georefrencing properties of the reference frame. Once the satellite images have been resampled, the sampled satellite images were then subjected to further GIS analysis.

Change Detection in Land Use /Land Cover

The detection of changes in land use /land cover was based on reconnaissance survey of the study area, which is mainly aimed at identifying and documenting the different land use/ land cover classes and collect the GPS coordinates of the various land use classes. These land use/ land cover sites for which GPS coordinates were collected were the training sites for classifying the satellite image of the study area.

Using the GPS coordinates as a guide, the location of the training sites earlier taken in the field were located on the satellite image and digitized. This allowed the GIS software to determine the spectral signature of the different classes using a convenient classification routine (usually maximum likelihood), the three images were classified into different land use classes.

The pixel value of each classified image was then changed to integer values so that the integer value assigned for a class will be the same for a similar class in the rest of the image. By taking two output (classified) images at a time, one image will be divided by the other. The output of this map algebra is a map consisting of cluster of similar, pixel values. The areas that have pixel values of "1" are areas that have not experienced any change, the areas with pixel values above 1 or below 1 are the areas that have changed. The various clusters were digitized and over laid on the classified map one after the other, in order to allow the determination of the extent and magnitude of the changed classes.

Evaluation of Land Use/Land Cover Classification

The accuracy of the Land use/Land cover classification was confirmed through ground truthing, which involves resampling of land uses and monuments such as Schools, Churches and Mosques and other buildings and historic land uses which have existed in the study area within the study period.

Eight land use/ land cover classes were identified. They include:

- Built up areas comprising of residential and institutional buildings and associated land cover such as pavements and tarred roads.
- **Water Bodies** – Mainly rivers and streams.
- **Crop Land** – Cultivated lands including Agro forestry and irrigated lands.
- **Grass lands** – Areas covered with grasses.
- **Green Landscape Belts** – Areas covered with trees and shrubs (ornamental and economic trees)
- **Marshy Green Land** - Water logged areas .

- **Open Space**- Unoccupied /undeveloped parcel of land.
- **Forest Gallery:-** A collection of different plant species especially along the streams.

RESULTS AND DISCUSSIONS

The characteristics of the factors that causes changes in the pattern of land use/ land cover over the study are is dynamic over the 30 yrs period of this study, these factors which are rapid growth rate of population and urban expansion, have cause a considerable irregular land use over the period. As depicted on figures 2a, 2b and 2c which are classified images of the study area in 1975, 1987 and 2005.

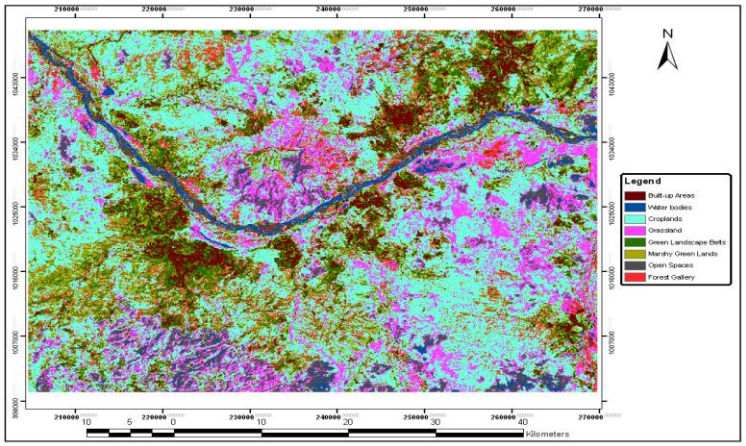

Figure 2a: Extent of Land Cover Change in 1975

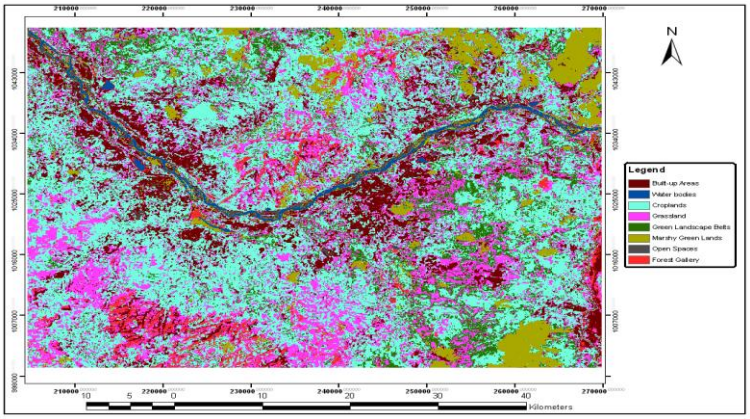

Figure 2b: Extent of Land Cover Change in 1987

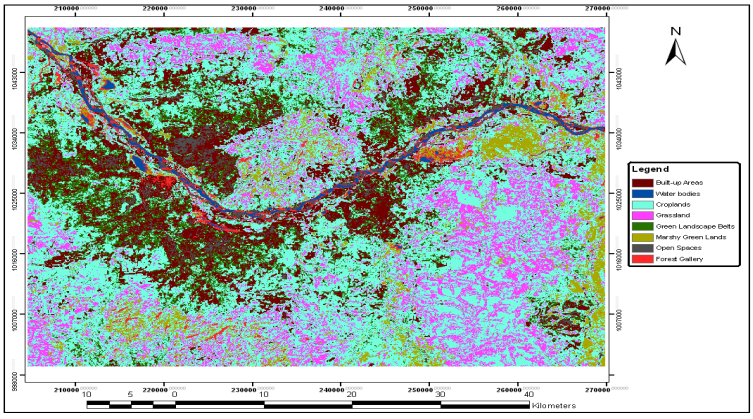

Figure 2c: Extent of Land Cover Change in 2005

The size of the whole area is 3288.5km^2, the distribution of the area for 1975,1987 and 2005 in to Land use/ Land cover classes was summarized in table 1.

Table 1: Land Use/ Land Cover Changes in the Study Area (1975-2005)

Land Use Class	1975 (km^2)	% of LU/LC	1987 (km^2)	% of LU/LC	2005 (km^2)	% of LU/LC
Built up areas	173.20	5.3	453.80	13.8	509.50	15.5
Water bodies	60.70	1.8	40.40	1.2	33.70	1.00
Crop land	1,373.00	41.8	1,354.20	41.2	1,585.80	48.2
Grass land	453.60	13.8	703.20	21.4	492.50	14.9
Green landscape belt	360.00	10.9	366.70	11.10	313.20	9.6
Marshy Green land	386.30	11.7	227.4	6.9	200.70	6.1
Open Space	188.20	5.7	30.60	0.9	81.40	2.5
Forest Gallery	293.50	8.9	112.20	3.45	71.70	2.2
Total	**3288.5**	**100**	**3288.5**	**100**	**3288.5**	**100**

Table 1 shows changes within the land use classes along a segment of river Benue. The most noticeable change is in built up area which expanded by about 162% between 1975-1987. This expansion could be attributed to the growth in population and increasing demand for space. The existing settlements within the flood plain have significantly expanded through the development of new dwelling units at their periphery as housing estate or the outward expansion of the towns as witnessed in Yola and Jimeta townships. New settlements such as Semde and Kabawa have emerged, Semde as a vassal of Njoboliyo which controls some fish ponds at the foot of Bagale hills where Semde is located, and Kabawa, a settlement populated by Hausa migrants that settled there as a result of their displacement from their homeland by the Sudano Sahelian drought. Between 1987 and 2005 there was also a growth of built up area by 13.8 %, this growth could also be explained by the same factors that were responsible for the growth in 1975-1987. The implication of the expansion in the built area is the proliferation of impervious surfaces which alter the amount of the water and sediment that was delivered to the channel, and this affects the channel pattern. No measurement of sediments load exist for the channel, possible contribution of sediment load generated by the catchment could only be considered using indirect sources of evidence, such as by inference from land use changes and narrowing of the channel width which is caused by avulsion along the river bank.

There is also a marked expansion in crop lands between 1987 and 2005 by 7.0%. This is partly responsible for stripping the land of its vegetal cover especially during land preparation, weakening the banks as the binding affect of vegetation root is absent for a longer period within the cropping season and thus rendering the bank more vulnerable to erosion.

Increasing rate of vegetation clearance is also a major factor in the diminishing of the forest gallery along the banks of river Benue as evidenced by the reduction in the forest cover by 60% between 1975 and 1987 and further by 37.25% between 1987 and 2005. The river segment traverse through a major pastoral block (Tukur and Ardo,1999) and this has a role in the changes of the grass land areas bordering the river channel were as the grass land expanded by about 55% between 1975 and 1987(as a result of moisture residue along the banks of the river Benue which recedes after its impoundment in the Cameroon republic), there is a sharp drop in this class by 30% between 1987 and 2005, due to mainly intensive grazing as the flood plain of river Benue remains the major pasture especially in dry season.

The general pattern of land use/land cover changes is graphically represented in Figure 3.

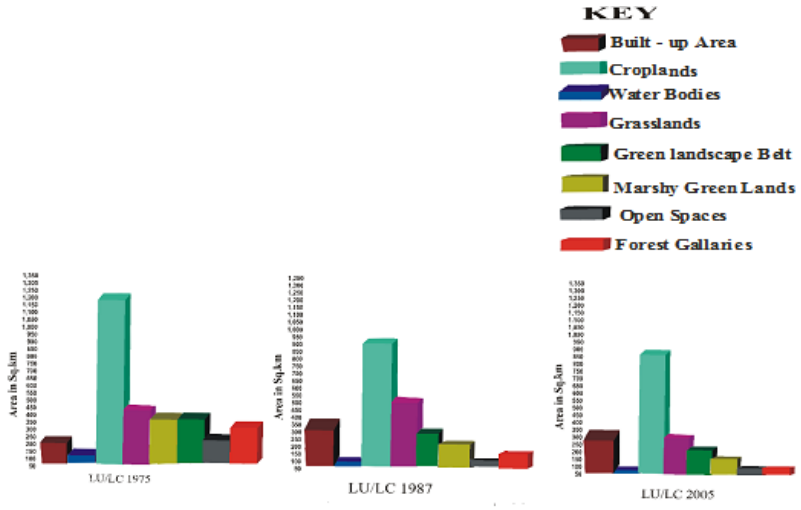

Figure 3: Land Use/Land Cover in 1975, 1987 and 2006

CONCLUSIONS

In conclusion, the general pattern of LU/LC in the study area is such that over the 30 yrs period there has been tremendous expansion of built up area, and crop land and there is a commensurate reduction in forest gallery, marshy areas and water bodies. Studying the trajectory of LU/LC change in the area in very important for land resources management, as well as management of river Benue for sustainable micro economic development within the area. In view of the dwindling of the vegetal cover within the study area, and its far reaching implication for ecology and morphology of river Benue, it is very important to adapt afforestation and agro forestry for the sustenance of bank stability, soil quality and ecological integrity of river Benue.

REFERENCES

1. Duadze, S.E.K (2004) Land use and Land cover study of the Savannah Ecosystem in the Upper West region (Ghana) Using remote sensing ZEF Bonn, University Of Bonn, Germany
2. Estes JE, Stow D, Jenson S.R (1982) Monitoring LU/LC changes. In Remote sensing for Resource Management elited by C.5 Johannsen and J.L Sanders (10wai Soil conservation society of America
3. Gordon S (1980). Utilizing Landsat imagery to monitor land use change:A case study of Ohio. Remote Sensing of Environ., 9, 189-196.
4. Howarth J.P and Wickware,GM (1981) procedure for change detection using Land sat digital data. Int J. Remote Sensing, 2:277 – 291
5. IGBP/IHDP (1999) Land use and Land cover change implementat.ion strategy. IGBP Report 48 and IHSP Report 10 IGBP Secretariat. Stockholm Sweden Pp 287
6. Joyce AT, Iwey JH, Burns GS (1982). The use of Landsat MSS data for detecting land use changes in forest land. Proceedings of the 14thInternational Symposium on Remote Sensing of Environment held inCosta Rico in 1982 (Ann Arbor, Michigan: Environmental ResearchInstitute of Michigan), pp. 979-988.
7. Mas JF (1999). Monitoring land cover changes: a comparison of change detection techniques. Int. J. Remote Sensing, 20(1): 139-152.

8. Richardson AJ, Milne AK (1983). Mapping fire bums and vegetation regeneration using principal components analysis. Proceedings of IGARSS' 83 held in San Francisco in 1983 (New York: I.E.E.E.), pp.51-56.
9. Singh A (1984). Tropical forest monitoring using digital Landsat data in north eastern India. Ph.D. thesis, University of Reading, Reading,England, p. 226.
10. Todd, WJ (1977) Urban and regional land use change detected by using land sat data J. Res, Us Gred-Surv, 5: 527 – 534